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EPIDEMIOLOGICAL REPORT NO. 12-HF-17G072-10

MILITARY AIRBORNE TRAINING INJURIES AND INJURY RISK FACTORS FORT BRAGG, NORTH CAROLINA, JUNE-DECEMBER 2010

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13. SUPPLEMENTARY NOTES

14. ABSTRACT The Military Training Task Force of the Defense Safety Oversight Council funded a project to compare injury rates between the older T-10 parachute and the newer T-11 parachute. This is a preliminary report on injury incidence and injury risk factors with the T-10 parachute. From 17 June to 3 December 2010, injury and operational data were systematically collected on all jump operations performed by the 82nd Airborne Division (Fort Bragg, North Carolina) while using T-10D parachutes. Data on injured jumpers included injury diagnosis, anatomical location of the injury, and how the injury occurred. Operational data from flight manifests and flash reports included the date and time of the jump, type of jump (administrative/non-tactical (Hollywood) or combat load), unit involved, drop zone, entanglements, Soldiers' rank, jump order (order in which the Soldiers exited the aircraft), door side (right, left, tailgate), aircraft type, and time from redeployment to jump operation. Dry bulb temperature, humidity, and wind speed were obtained using a Kestrel® Model 4500 pocket weather tracker. There were a total of 23,031 jumps resulting in 242 injured Soldiers for a crude injury incidence of 10.5/1,000 jumps. There were 12 entanglements for an entanglement incidence of 0.52/1,000 jumps. In 2/3 of the injury cases (n=160) an event associated with the injury was determined and these included ground impact (n=120), static line problems (n=17), tree landings (n=6), entanglements (n=6), aircraft exits (n=4), landing on equipment (n=2), dragging by parachute on ground (n=2), parachute risers (n=2), and lowering line (n=1). The incidence of static line injuries evacuated to the hospital (more serious) was 0.30/1,000 jumps, twice as high as the incidence of 0.15/1,000 jumps reported from 1994 to 1996 at Fort Bragg. Univariate analysis (chi-square statistics) showed that higher injury risk was associated with night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, higher humidity, C17 Globemaster or C130 Hercules aircrafts (compared to the other aircraft), exits through doors (as opposed to tailgates), the Geronimo drop zone (at Fort Polk, Louisiana), entanglements, and longer times from redeployments to jumps. Multivariate backward stepping logistic regression indicated that independent risk factors for injuries included night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, and entanglements. Static line injuries appear to be higher than in the past and training and procedural options to reduce injuries of this type should be considered. An appreciation of injury incidence, how airborne injuries occur, and factors increasing injury risk can assist medical and operational planners in further reducing the incidence of injury during airborne training operations.

15. SUBJECT TERMS Flight manifest, flash reports, administrative/non-tactical, Hollywood, combat load, drop zone, entanglements, rank, door position, tailgate, C130 Hercules, C17 Globemaster, C23 Sherpa, C160 Transall, CH47 Chinook, UH60 Blackhawk, redeployment, temperature, humidity, wind speed, parachute landing fall, tree landing, static line, safety

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EXECUTIVE SUMMARY
EPIDEMIOLOGICAL REPORT NO. 12-HF-17G072-10
MILITARY AIRBORNE TRAINING INJURIES AND INJURY RISK FACTORS
FORT BRAGG, NORTH CAROLINA, JUNE-DECEMBER 2010

1. INTRODUCTION AND PURPOSE.

a. In 2003, the Secretary of Defense directed the Department of Defense to reduce preventable mishaps or injuries. The Under Secretary of Defense for Personnel & Readiness responded by establishing the Defense Safety Oversight Council (DSOC) which chartered nine task forces to develop recommendations to reduce preventable injuries. One of these task forces was the Military Training Task Force (MTTF), which worked to decrease injuries during military training activities. Each year the MTTF prioritized a number of projects directed at training-related injury reduction. In 2010, the MTTF funded a project to have the United Stated Army Public Health Command (Provisional) (USAPHC (Prov)), formerly the U.S. Army Center for Health Promotion and Preventive Medicine, and Concurrent Technology Corporation (*CTC*) compare injury rates between the older T-10 parachute and the newer T-11 parachute. The project began in June 2010 with the cooperation of the 82nd Airborne Division.

b. In October 2010, *CTC* requested that USAPHC (Prov) provide an analysis of the initial data collected. It was agreed that this report would cover information collected from the beginning of the project until early December 2010. However, there were delays in implementing the T-11 parachute within the 82nd Airborne Division and up to December 2010, only 99 jumps with the T-11 parachute had been made. Thus, it was agreed that the data analysis would focus on injuries and injury risk factors associated with the T-10 parachute. Once the new T-11 parachute was phased into the 82nd Airborne Division, injury and operational data would continue to be collected and a final report produced comparing the T-10 results to that of the T-11. The purpose of this report is to provide preliminary information on the project by examining injury rates and injury risk factors during training with the T-10D parachute in an operational airborne unit in the United States Army.

2. METHODS.

a. From 17 June to 3 December 2010, injury and operational data were systematically collected by the investigators on all jump operations performed by the 82nd Airborne Division while using T-10D parachutes. For each jump operation, one or more investigators were present on the drop zone. For each injured jumper, the

investigators recorded the injured Soldier's name, initial injury diagnosis, anatomical location of the injury, and how the injury occurred. The initial diagnosis was provided by the medic or physician's assistant. If the injured Soldier was evacuated to the hospital, a physician obtained a final diagnosis from medical records.

b. Operational data were collected from routine reports (flight manifests and flash reports) issued by the 82nd Airborne Division. These data included the date and time of the jump, unit involved, drop zone, entanglements, Soldiers' rank, jump order (order in which the Soldiers exited the aircraft), door side (right, left, tailgate), aircraft type, type of jump, and time from redeployment to jump operation. Entanglements were physical contact between two or more jumpers that interfered with a normal parachute descent. Type of jump could be administrative/non-tactical (Hollywood) or combat loaded. In addition to data from routine reports, weather data (dry bulb temperature, humidity, and wind speed) were obtained by the on-site investigators using a calibrated Kestrel® Model 4500 pocket weather tracker (Kestrel® is a registered trademark of Nielsen-Kellerman Co.)

c. Cumulative injury incidence was calculated as Soldiers with one or more injuries divided by the total number of jumps multiplied by 1,000 (injuries/1,000 jumps). The chi-square test of proportions was used to assess the univariate association between the operational data and injuries. Backward stepping multivariate logistic regression was used to model the association between injuries and the injury risk factors in combination.

3. RESULTS.

a. There were a total of 23,031 jumps resulting in 242 injured Soldiers for a crude injury incidence of 10.5/1,000 jumps. Forty-six percent of injuries (n=112) involved the lower body and 54 percent (n=130) involved the upper body. The most common injury/anatomic locations combinations were closed head injuries/concussions (n=74), ankle fractures (n=21), ankle sprains (n=20), low back sprains (n=14), hip contusions (n=8), upper arm abrasions/lacerations (n=6) and lower back fractures (n=4). There were 12 entanglements in the 23,031 jumps, resulting in an entanglement incidence of 0.52/1,000 jumps.

b. In 2/3 of the cases (n=160) it was possible to determine the event associated with the injury. These included surface impact (n=120), static line problems (n=17), tree landings (n=6), entanglements (n=6), aircraft exits (n=4), landing on equipment (n=2), dragged by parachute on ground (n=2), parachute risers (n=2), and lowering line (n=1).

c. Univariate analysis showed that higher injury risk was associated with night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, higher humidity, C17 Globemaster or C130 Hercules aircrafts (compared to the other aircraft),

exits through doors (as opposed to tailgates), the Geronimo drop zone (at Fort Polk, Louisiana), entanglements, and longer times from redeployments to jumps. Multivariate logistic regression indicated that independent risk factors for injuries included night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, and entanglements.

4. CONCLUSIONS AND RECOMMENDATIONS. The present investigation found an injury incidence of 10.5/1,000 jumps for 82nd Airborne Division Soldiers involved in Airborne training missions with the T-10D parachute from 17 June to 3 December, 2010. Where an event associated with the injury could be determined, the largest risks were associated with ground impacts and static line problems. Static line injuries appear to be higher than in the past and training and procedural options to reduce injuries of this type should be considered. Risk factors for injuries included night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, higher humidity, C17 and C130 aircraft (compared to other aircraft), exits through doors (as opposed to tailgates), entanglements, and longer times from redeployment to the jump operation. An appreciation of injury incidence, how airborne injuries occur, and factors increasing injury risk can assist medical and operational planners in further reducing the incidence of injury during airborne training operations.

CONTENTS

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FORT BRAGG, NORTH CAROLINA, JUNE-DECEMBER 2010

1. REFERENCES. Appendix A contains the scientific/technical references used in this report.

2. INTRODUCTION AND PURPOSE.

a. In 2003, the Secretary of Defense directed the Department of Defense to reduce preventable mishaps or injuries. The Under Secretary of Defense for Personnel & Readiness responded by establishing the Defense Safety Oversight Council (DSOC) which chartered nine task forces to develop recommendations to achieve this objective. One of these task forces was the Military Training Task Force (MTTF), which worked to decrease injuries during military training activities. Each year, the MTTF prioritized a number of projects directed at training-related injury reduction. In 2010, the MTTF funded a project to have the United States (U.S.) Army Public Health Command (Provisional) (USAPHC (Prov)), formerly the U.S. Army Center for Health Promotion and Preventive Medicine, and Concurrent Technologies Corporation (*CTC*) examine the effectiveness of a parachute ankle brace (PAB) for reducing injuries in operational airborne units. Previous studies had shown that the PAB reduced ankle injuries by about half during basic airborne training at Fort Benning, Georgia.[1] However, the operational airborne community saw little need for the PAB since the new T-11 Advanced Tactical Parachute System was soon to be fielded and anecdotal information suggested that it would substantially reduce injury incidence. Based on this feedback, the MTTF approved a refocus of the airborne injury reduction effort such that injury rates between the older T-10 parachute and the newer T-11 parachute would be compared. The basic project design was to collect injury and operational data on the T-10 parachutes while they were still being used by the 82nd Airborne Division (Fort Bragg, North Carolina) and then collect the same data on the new T-11 parachutes as they were phased into the inventory.

b. The USAPHC worked with the 82nd Airborne Division to understand the operational training environment and how to collect the data to determine if there were differences in injury rates between the T-10 and T-11 parachute. Trip reports on the two major coordination visits are at Appendix B. The DSOC provided resources to *CTC* to fund personnel who would observe parachute operations by the 82nd Airborne Division. These personnel were to systematically acquire data on injuries sustained during airborne training jumps as well as environmental and operational conditions that were likely to affect injury rates.

c. In October 2010, *CTC* requested that USAPHC (Prov) provide an analysis of the initial data collected. The reason for this was that the T-10/T-11 parachute project was one of several efforts currently funded under National Defense Center for Energy and

Environment (NDCEE) Task 0517, which ended in March 2011. Accordingly, a draft task report, containing pieces of all the funded efforts under that task (including this investigation) was due in January 2011, 60 days before task completion, to allow for Government review and *CTC* comments. Beginning in March 2011, the T-10/T-11 effort will be funded under NDCEE Task 568.

d. It was agreed between *CTC* and USAPHC (Prov) that the current report would cover information collected from the beginning of the project until early December 2010. However, there were delays in implementing the T-11 parachute within the 82nd Airborne Division and up to December 2010 only 99 jumps with the T-11 parachute had been made. Thus, USAPHC (Prov) and *CTC* agreed that the data analysis would focus on injuries and injury risk factors associated with the T-10 parachute. Once the new T-11 parachute was phased into the 82nd Airborne Division, injury and operational data would continue to be collected and a final report produced comparing the T-10 and T-11 results.

e. The purpose of this report is to provide a preliminary summary on the project by examining baseline injury rates and injury risk factors during training in an operational U.S. Army airborne unit employing the T-10D parachute. We examine many of the risk factors that previous studies have examined but expand the knowledge base by examining some new factors. In addition, we look at significant risk factors in a multivariate analysis.

3. AUTHORITY. Under Army Regulation 40-5[2], the USAPHC (Prov) is responsible for providing epidemiological consultation services. This project was approved and funded by the DSOC in an effort to determine the injury-reduction effectiveness of the new T-11 parachutes when compared to the older T-10D parachutes. The project was reviewed by the USAPHC (Prov) Human Subject Protection Office employing the criteria of the Council of the State and Territorial Epidemiologists[3]. It was determined that this project constituted public health practice. The *CTC* requested a preliminary analysis of the data and USAPHC agreed to provide this initial analysis.

4. BACKGROUND.

a. Since military airborne training operations were initiated in the U.S. Army shortly before World War II, physicians and scientists have worked with the operational community to enhance safety and increase the probability that Airborne Soldiers arrive on the ground ready for their operational missions. These efforts coupled with continuous improvements in parachute technology, aircraft exit procedures, and ground landing techniques substantially reduced the number of injuries over time. Early estimates of military parachuting injury rates in the World War II era were 21 to 27/1,000 descents.[4,5] A summary of studies conducted after this time (up to 1998) indicated that airborne injuries averaged about 6/1,000 jumps.[6] Nonetheless, different injury

definitions, dissimilar methods of data collection, and diverse operational conditions can result in widely different injury rates.[7-10]

b. Table 1 displays previous studies that have examined military airborne injuries and provides injury definitions, military units involved, methods of injury data collection, and crude injury incidences for these investigations. Studies are arranged in groups that include injuries in airborne basic training, operational units, single jump operations, and combat operations. Early studies identified a number of factors that elevated injury risk. These included high wind speeds, night jumps, heavy loads, and rough landing zones.[5, 11] Later studies identified such extrinsic risk factors as smaller diameter canopies, fixed wing aircraft (verses rotary wing), extra equipment, more jumpers in the air, and higher temperatures; identified intrinsic risk factors included female gender, older age, greater body weight, lower upper body muscular endurance, lower aerobic fitness, and prior injuries.[7, 12-17] Most studies only carried out univariate analysis of these risk factors and few[1, 7, 16] performed multivariate analysis that would allow identification of independent risk factors and determine how risk factors might interact.

Table 1. Military Airborne Injury Incidences

Group	Study	Injury Definition	Group, Location, Date (if available in article)	Collection of Injury Data	Jump Conditions (if specified)	Crude Injury Incidence (injuries/jumps= injuries/1,000 jumps)
Airborne Basic Training	Tobin et al. 1941[4]	Injuries recorded by training battalion	501st and 502rd Parachute Battalion, Parachute School, Ft Benning Georgia, August 1940 to August 1941	Personnel records		121/4,490= 27.0/1,000[a]
	Pozner 1946[18]	Not clear	3th Parachute Training Unit, British, January 1944 to June 1945	Consolidated accident statistics		190/66,408= 2.9/1,000[b]
	Hallel & Naggan 1975[11]	Paratrooper who received medical treatment on drop zone or several days following jump	Mixed basic course and refresher course, Israeli	Punch cards identifying injuries on drop zone		723/83,718= 8.6/1,000[a]
	Pirson & Verbiest 1985[14]	Not clear	Basic jump course; some Soldiers in refresher training, Belgium, 10-year period	Accident reports identifying injuries on the drop zone		5/1,000 [c]
	Lowdon & Wetherill 1989[19]	Fractures, head injuries, dislocations, and others	Training Services Parachute Training Airfield near Oxford, British, 6-year period	Emergency room records, 6 years		205/51,828 = 4.0/1,000
	Pirson & Pirlot 1990[13]	Not clear	Paracommando basic course, Belgium, February 1985 to March 1988	Not clear		53/15,043= 3.5/1,000

Group	Study	Injury Definition	Group, Location, Date (if available in article)	Collection of Injury Data	Jump Conditions (if specified)	Crude Injury Incidence (injuries/jumps= injuries/1,000 jumps)
	Bar-Dayan et al. 1998[20]	Casualty that prevented further jumps for at least 2 days	Parachute training, with minority of jumps for refresher course or maneuvers, Israel	Accident reports completed by physicians		388/43,542= 8.9/1,000
	Amoroso et al. 1998[21]	Any musculoskeletal or traumatic condition occurring between aircraft exit & march off drop zone that resulted in inability to clear the drop zone, or diagnosed in medical clinic or hospital emergency room	Airborne School, Ft Benning, GA	Drop zone with follow-up at hospital/emergency room and patient medical records		35/3,674= 9.5/1,000
	Knapik et al. 2008[7]	Questionnaire item asking if student injured during jump week	Airborne School, Ft Benning GA, June 2005 to January 2006	Questionnaire responses		119/6,708= 17.7/1,000
	Knapik et al. 2008[1]	Physical damage to the body recorded on updated injury report	Airborne School, Ft Benning GA, April 2005 to December 2006	Drop zone injuries reported by medics with follow up at clinic/hospital		596/102,784= 5.8/1,000
Operational Units	Essex-Lopresti 1946[5]	Causalities reported by the medical officer on the drop zone	British 6th Airborne Div, January to November 1944	Drop zone		437/20,777= 21/1,000
	Neel 1950[22]	Time loss injuries	82nd Airborne Division, Ft Bragg, NC, 1946-1949	Unclear		1,018/174,220= 5.8/1,000
	Roche 1960[23]	Events causing hospitalization and time loss from duty	101st Airborne Division, 1956 to 1959	Injury statistics from 101st Airborne Division		1,206/355,886= 3.4/1,000
	Hadley & Hibst 1984[24]	Injury resulting in loss of duty for 1 day or more	82nd Airborne Division, Ft Bragg, NC, Fiscal Year 1979 to 1980	Collected “reportable injuries”		117/186,717= 0.6/1,000
	Lillywhite 1991[16]	Parachute injury seen by medical personnel on the drop zone	5th Airborne Brigade, British	Medical personnel on drop Zone		379/34,236= 10.9/1,000
	Farrow 1992[25]	Injury requiring evacuation from drop zone, withdrawal from exercise, duty restriction, or hospitalization	Parachute Battalion Group, Australian, March 1987 to December 1988	Injuries recorded on a standard Field Medical Report		63/8,823= 7.1/1,000
	Kragh et al. 1996[8]	Acute anatomical lesion resulting in a duty restriction as a result of parachuting	3d Ranger Battalion, Ft Benning GA, USA, 55-month period	Medical records of unit Soldiers		163/7,569= 21.5/1,000

Group	Study	Injury Definition	Group, Location, Date (if available in article)	Collection of Injury Data	Jump Conditions (if specified)	Crude Injury Incidence (injuries/jumps= injuries/1,000 jumps)
	Craig & Morgan 1997[26]	Injury from time boarding aircraft to ground impact and identified by ER staff as due to parachuting	Ft Bragg NC, USA, May 1993 to December 1994	Emergency room records		1,610/200,571= 8.0/1,000
	Schumacher et al. 2000[27]	Parachute-related injury that limited duty for 1 or more days	3d Ranger Battalion, Ft Benning GA, USA, October 1996 to December 1997	Database containing all sick call and emergency room visits		210/13,782= 15.2/1,000
	Craig & Lee 2000[17]	Injury from time boarding aircraft to ground impact and identified by ER staff as due to parachuting	XVIII Airborne Corps, Ft Bragg NC, USA, May 1994 to April 1996	Emergency room records		1,972/242,949= 8.1/1,000
	Hay 2006[28]	Injury requiring evacuation from drop zone, admission to medical facility, withdrawal from exercise, or duty restriction	3rd Battalion, Royal Australian Regiment & A Field Battery, January to December 2004	Audit of unit medical records	Daylight jumps only	21/1,375= 15.3/1,000
	Hughes & Weinrauch 2008[29]	Injuries recorded in unit medical records	4th Battalion Royal Australian Regiment, February 2004 to February 2005	Audit of medical records		28/554= 50.5/1,000
Single Jump Operation	Timboe 1988[9]	Injuries treated by medical personnel on the drop zone	82nd Airborne parachuting into Ft Irwin, March 1982	Drop zone injuries	Early morning jump, combat loads, rough landing zone, high winds	158/1,780= 88.8/1,000
	Kragh & Taylor 1996[8]	Concussions, fractures, contusions, sprains, strains, lacerations	1/75th Ranger Battalion, jump onto Ali Al Salem Airfield, Kuwait, December 1991	Drop zone injuries recorded by medical personnel	Night jump, combat loads, high winds (10-13 knots), airfield and rocky desert drop zone	71/475= 149.5/1,000
	Craig et al. 1999[10]	Injury from time Soldier boarded aircraft until exiting the drop zone	US and British units jumping at Ft Bragg NC, May 1996	Drop zone injuries recorded by medical personnel, or at emergency room	Low visibility, ground fog, winds did not exceed 8 knots, temp=55^{0}F	US 67/3,066= 21.9/1,000 British 49/1688= 29.0/1,000
	Buxton et al.2006[30]	Not clear	British and French parachute operation	Not clear		41/740= 55.4/1,000
Combat Operations	Miser et al. 1995[31]	Any injury reported by the Ranger during an interview	2/75th Ranger Battalion, jump onto Panama Airfield (Operation Just Cause), December 1989	Interview	Night jump, combat load, airfield drop zone	252/486= 518.5/1,000

Group	Study	Injury Definition	Group, Location, Date (if available in article)	Collection of Injury Data	Jump Conditions (if specified)	Crude Injury Incidence (injuries/jumps= injuries/1,000 jumps)
	Kotwal et al. 2004[32]	Physical damage to the body as a result of parachuting, from aircraft exit to release of parachute harness on ground	75th Rangers Regiment; 4 combat jumps: 2 in Iraq (Operation Iraqi Freedom) & 2 in Afghanistan (Operation Enduring Freedom), 2001 to 2003	Ranger electronic medical database	Winds 1-8 knots, night jumps, combat loads, 40-60^{0}F	76/634= 120.0/1,000

[a]Injury incidence cited by authors is incorrect
[b]Includes deaths
[c]This is the incidence cited in the article but the article does not provide numerators and denominators

5. METHODS. The 82nd Airborne Division of the XVIII Airborne Corps is an airborne infantry unit garrisoned at Ft Bragg, North Carolina. Its mission is to, within 18 hours of notification, strategically deploy, conduct parachute assaults, and secure key objectives for follow-on military operations in support of U.S. national interests. The division regularly conducts jump operations to keep Soldiers trained for Airborne forcible entry missions. From 17 June to 3 December 2010 injury and operational data were systematically collected by the investigators on all jump operations performed by the 82nd Airborne Division.

a. Jump Operations. For all Airborne training jumps, Soldiers donned T-10D parachutes and loaded onto fixed wing or rotary-wing aircraft. Prior to loading the aircraft, their names, ranks, and location in the jump order were recorded on a jump manifest. After the Soldiers had completely boarded, the aircraft departed for the drop zone. Along with the jumpers, the aircraft had a Jumpmaster Team normally consisting of a primary jumpmaster (PJ), assistant jumpmaster (AJ), and a minimum of two safeties. The PJ and AJ were usually the last two jumpers to exit the aircraft, while the safeties remain onboard and returned with the aircraft to the departure airfield. These individuals had responsibility for the safety of all on-board jump personnel. During flight, Soldiers were seated until the jumpmaster issued the command to stand up. At this point, the jumpers stood up and attached the static lines of their parachutes to a cable in the aircraft and awaited further commands from the jumpmasters for their door. Once the Air Force turned over control of the paratroop door to the jumpmasters, the jumpmasters verified specific geographic land marks and ground markings to ensure the aircraft was on the proper approach into the drop zone, and then instructed the first jumper to stand-by in the door. Once the aircraft reached its Aerial Release Point, the jumpmaster issued the command “GO.” On this command, the jumpers exited the aircraft in quick succession. As each jumper exited, the static line pulled open the main parachute, providing the canopy that slowed the jumper’s descent. On contact with the ground, the jumpers executed a parachute landing fall (PLF) to break the impact of the landing.[6, 28] After landing, and while lying on the ground, the jumper collapsed the

parachute canopy using a quick release device on the parachute harness. The jumper then stood up, bundled the parachute, and prepared for the follow-on operation.

b. Injury Data.

(1) During all airborne operations, the drop zone safety officer (DZSO) was the individual on the ground who had responsibility for all actions and the safety of all personnel on the drop zone. The DZSO was located at the personnel release point (PRP) of the drop zone, the point at which the first jumper should land. Depending on the number of Soldiers involved in the airborne operation, there were from 1 to 6 ambulances located on the drop zone near the DZSO. Each ambulance had 2 to 4 Army-trained medics, and for larger operations a physician's assistant (PA) was present. Once all Soldiers who had jumped were on the ground, the ambulances drove across the drop zone and provided medical care to injured jumpers. They returned injured jumpers to a collection point near the DZSO.

(2) For each jump operation, one or more investigators were present on the drop zone. Once a Soldier was brought to the collection point, the investigators recorded the injured Soldier's name, initial injury diagnosis, anatomical location of the injury, and how the injury occurred. The initial diagnosis was provided by the medic or PA. If the injury was minor, the Soldier could be released on the drop zone by the medic or PA, but usually Soldiers were taken to a hospital or clinic for follow-up care. Once in the hospital, the medical care provider who saw the Soldier generated a record in the Armed Forces Health Longitudinal Technology Application (AHLTA) that included a more detailed diagnosis and anatomical location. A physician examined the AHLTA record and provided a final diagnosis and anatomical location for the injury. If the Soldier was released on the drop zone, the final diagnosis and anatomical location were those obtained on the drop zone. If the Soldier was taken to the hospital the final diagnosis and anatomical location were those determined by the physician from the AHLTA record. During operations with larger numbers of Soldiers, an additional medic was stationed at the hospital to record injuries and to assure that all data were captured. An injury was defined as any physical damage to the body, seen by the medic or PA on the drop zone, from the time the Soldier was seated in the aircraft until the time the Soldier completed the parachute landing and removed the parachute harness on the ground.

c. Operational Data.

(1) Planned jump operations were published in a document called the "air letter". The air letter contained the projected date and time of the jump, unit involved, drop zone, projected number of jumpers, aircraft, and other information. This allowed the investigators to be on-site for each of the jumps. After the jump operation was completed, a "flash report" was issued that contained information on the actual time of

the jump, unit, entanglements, and some data on injured jumpers. From the time of day and visual operations of the drop zone, investigators could determine if the jump had occurred in daylight (day) or after dark (night). Information on entanglements were obtained from a narrative section on the flash report. Entanglements involved physical contact between two or more jumpers that interfered with a normal parachute descent. From the narrative description on the flash report it was possible to determine if the jumpers were able to disentangle before ground contact or if they remained entangled to the ground. Injury data on the flash report was used to enhance information obtained on the drop zone and to ensure all injuries were captured.

(2) Prior to Soldiers loading onto the aircraft, a jump manifest was created. The jump manifest contained information on the Soldiers' rank, name, jump order (order in which the Soldiers exited the aircraft), door side (right, left, tailgate), aircraft type, and the type of jump. Type of jump could be administrative/non-tactical (Hollywood) or combat load. For an administrative/non-tactical jump operation, Soldiers were dressed in Army combat uniforms, advanced combat helmets, and T-10D parachutes with attached reserve parachutes. For combat loaded jumps, the Soldiers additionally wore weapons containers (for rifles), and rucksacks. The rucksacks and weapons containers were attached to the jumpers' harnesses by quick release straps and a lowering line. The lowering line served to drop the rucksack and container about 15 feet below the Soldier's body while remaining attached to the Soldier. The quick release was activated before ground contact.

(3) Weather data were obtained by the on-site investigators using a calibrated Kestrel® Model 4500 pocket weather tracker. As each aircraft came over the drop zone, investigators recorded the ground dry bulb temperature, humidity, and wind speed. The lowest and highest wind speeds were obtained from 3 minutes prior to the aircraft passing over the drop zone until all jumpers had landed. (Kestrel® is a registered trademark of Nielsen-Kellerman Co.)

(4) Some units had been deployed to Iraq or Afghanistan and were not able to jump while in-theater. Brigades were usually deployed for 1 year, although 2 battalions had deployed for only 5 months. Time from a Soldier's date of return to Fort Bragg through the jump date was calculated in months and called "time from redeployment to jump." For the purposes of this calculation, if a Soldier was in a unit that had deployed, it was assumed that the Soldier had deployed with that unit. While this was true for the large majority of Soldiers, it was not true for all Soldiers. Some Soldiers had stayed at Fort Bragg during the deployment serving as the rear detachment; some Soldiers came into the unit after the unit had returned; some Soldiers came back earlier or later than the larger group of Soldiers. Thus, the measure of time from redeployment to jump is a crude estimate.

(5) Most jumps were conducted on drop zones at Fort Bragg. However, during the survey period, three jump operations were conducted at other locations. These included Charleston, West Virginia (Clute drop zone); Little Rock Air Force Base, Arkansas (Little Rock drop zone); and the Joint Readiness Training Center (JRTC), Fort Polk, Louisiana (Geronimo drop zone). No flash report was filed for the operation at the JRTC and thus little operational data was available.

d. Data Analysis. A de-identified database was created that had one jump on each line along with operational data, weather, and injury information (the latter, if one occurred). Data analysis was performed using Predictive-Analytic Software, Version 18.0.0. To determine injury incidence, the numerator was the number of injured Soldiers and denominator was of the number of jumps. Cumulative injury incidence was calculated as Soldiers with 1 or more injuries divided by the total number of jumps and multiplied by 1,000 (injuries/1,000 jumps). The chi-square test of proportions was used to assess the univariate association between the operation/weather data (covariates or injury risk factors) and all injuries. Risk ratios (RR) and 95 percent confidence intervals (95 percent CI) were calculated by comparing the injury risk at a baseline level of the variable (indicated with a RR=1.00) to the risk at other levels of the variable. Covariates (risk factors) that were significantly ($p<0.10$) associated with injury incidence in the univariate analysis were included in a backward stepping multivariate logistic regression. In the multivariate analysis, simple contrasts with the baseline level of the variable (RR=1.00) were used. The dependent variable in the logistic regression was the presence or absence of an injury.

6. RESULTS.

a. A total of 23,031 jumps were made resulting in 242 injured Soldiers for a crude injury incidence of 10.5/1,000 jumps. Table 2 shows the types of injuries and the anatomical locations. Forty-six percent of injuries (n=112) involved the lower body and 54 percent (n=130) involved the upper body. The most common injury/anatomical location combinations were closed head injuries/concussions (n=74), ankle fractures (n=21), ankle sprains (n=20), low back sprains (n=14), hip contusions (n=8), upper arm abrasions/lacerations (n=6) and lower back fractures (n=4).

Table 2. Injuries by Type and Anatomical Location

	N	Proportion (%)
Injury Type		
Closed Head Injury/Concussion	74	30.6
Fracture	36	14.9
Sprain	34	14.0
Contusion	31	12.8
Strain	28	11.6
Abrasion/Laceration	17	7.0
Pain (not otherwise specified)	14	5.8
Muscle/Tendon Rupture	4	1.7
Dislocation	4	1.7
Anatomical Location		
Head	81	33.5
Ankle	43	17.8
Lower Back	27	11.2
Upper Arm	18	7.4
Knee	14	5.8
Shoulder	12	5.0
Hip	8	3.3
Thigh	7	2.9
Foot	6	2.5
Pelvis	6	2.5
Neck	5	2.1
Chest	4	1.7
Lower Arm	2	0.8
Ear	2	0.8
Elbow	2	0.8
Hand	1	0.4
Toe	1	0.4
Wrist	1	0.4
Finger	1	0.4
Face	1	0.4

b. There were 12 entanglements in the 23,031 jumps, resulting in an entanglement incidence of 0.52/1,000 jumps. Eight were entanglements to the ground, and four were freed before ground contact. There were eight injuries associated with these entanglements. Seven of the eight occurred among Soldiers who were entangled to the ground and one occurred in a Soldier who was freed before ground impact. Injuries among Soldiers entangled to the ground included a low back fracture (L4), a pelvic fracture, a closed head injury, a knee sprain, a neck strain, a strain in the pelvic area, and a hip contusion. The injury in the entanglement that was freed before ground contact was a fracture of the hand.

c. Table 3 shows the events associated with the injuries experienced by the Soldiers. In two-thirds of the injury cases (n=160), it was possible to determine the event associated with the injury, but in one-third of the cases it was not. Early in the investigation, these data were not systematically collected accounting for most of the missing events. When events could not be determined later in the investigation, it was because the Soldier was not sure how the injury had happened, or due to an inability to adequately interview the Soldier because they were evacuated too quickly. Most injuries were associated with ground impact and inability to execute a proper PLF. These included landing on uneven ground, on harder surfaces, because of drop zone obstructions (i.e., logs, rocks), or because of improper PLF procedures. Ground impact injuries, static line injuries, tree landings, entanglements, and problems with exit procedures accounted for 96 percent (n=154) of the known events associated with injury.

Table 3. Events Associated with Injuries

	N	Proportion of All Categories (%)	Proportion (%) of Known Activities (unknown removed)
Ground Impact (PLF Problems)	120	49.6	75.0
Static Line	17	7.0	10.6
Tree Landing	6	2.5	3.8
Entanglement	6	2.5	3.8
Aircraft Exits	4	1.7	2.5
Landed on Equipment	2	0.8	1.3
Dragged by Parachute on Ground	2	0.8	1.3
Parachute Risers	2	0.8	1.3
Lowering Line	1	0.4	0.6
Unknown	82	33.9	---

d. Table 4 shows the univariate associations between injury risk and the covariates. Higher injury risk was associated with night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, higher humidity, C17 Globemaster or C130 Hercules aircrafts (compared to the other aircraft), exits through doors (compared to tailgates), the Geronimo drop zone, entanglements, and longer times from redeployments to jumps.

Table 4. Univariate Association between Risk Factors and Airborne Injury Incidence

Variable	Level of Variable	Jumps (n)	Injury Incidence (cases/1,000 jumps)	Risk Ratio (95%CI)	Chi-Square p-value
Time of Day	Day	14,895	6.7	1.00	<0.01
	Night	8,020	17.5	2.60 (2.02-3.36)	
Jump Type	Administrative/Non-Tactical	14,791	5.9	1.00	<0.01
	Combat Load	8,240	18.8	3.19 (2.46-4.15)	
Lowest Wind Speed	0-1 knot	10,784	7.8	1.00	0.01
	2-5 knots	8,847	8.3	1.06 (0.76-1.45)	
	6-8 knots	1,746	14.9	1.91 (1.24-2.96)	
Highest Wind Speed	0-1 knot	2,512	10.0	1.00	<0.01
	2-4 knots	4,885	6.8	0.86 (0.40-1.14)	
	5-7 knots	8,361	6.6	0.66 (0.41-1.06)	
	8-10 knots	5,161	11.8	1.24 (0.77-1.98)	
	11-12 knots	458	22.4	2.19 (1.06-4.54)	
Dry Bulb Temperature	37-50 degrees F	1,917	1.6	1.00	<0.01
	51-70 degrees F	4,184	8.4	5.35 (1.65-17.36)	
	71-90 degrees F	9,954	9.5	6.10 (1.93-19.23)	
	91-104 degrees F	4,542	9.7	6.19 (1.93-19.91)	
Humidity	20-40%	6,447	7.4	1.00	0.09
	41-60%	5,330	9.2	1.24 (0.83-1.84)	
	61-80%	6,747	7.9	1.06 (0.72-1.57)	
	81-92%	2,073	13.0	1.74 (1.10-2.80)	
Aircraft	C130 Hercules (fixed wing)	17,248	11.5	1.00	<0.01
	C17 Globemaster (fixed wing)	2,255	16.0	1.39 (0.98-1.98)	
	C23 Sherpa (fixed wing)	1,011	1.0	0.09 (0.01-0.61)	
	C160 Transall (fixed wing)	784	7.7	0.67 (0.30-1.50)	
	CH47 Chinook (rotary wing)	1,271	0.8	0.07 (0.01-0.49)	
	UH60 Blackhawk (rotary wing)	462	0.0	-----	
Aircraft Exit Door	Left	9,160	12.1	13.83 (3.42-55.93)	<0.01
	Right	9,181	10.5	11.93 (2.94-48.35)	
	Tailgate	2,282	0.9	1.00	
Jump Order	1-5	4,266	9.1	1.00	0.31
	6-10	3,837	10.4	1.14 (0.74-1.77)	
	11-15	3,825	10.2	1.12 (0.72-1.74)	
	16-20	3,515	9.7	1.06 (0.67-1.67)	
	21-25	3,147	12.4	1.36 (0.87-2.11)	
	26-30	2,637	14.4	1.58 (1.01-2.46)	
	31-35	873	8.0	0.88 (0.39-1.95)	
	36-40	433	6.9	0.76 (0.23-2.44)	
	41-45	313	0.0	-----	
	46-51	154	13.0	1.42 (0.35-5.82)	
Military Rank	Junior Enlisted (E1-E4)	11,853	10.1	1.00	0.79
	Senior Enlisted (E5-E9)	8,030	11.1	1.10 (0.83-1.44)	
	Warrant Officer	198	10.1	1.00 (0.25-4.00)	
	Junior Officer (O1-O3)	2,152	8.8	0.87 (0.54-1.41)	
	Field Grade Officer (O4-O8)	567	14.1	1.39 (0.68-2.84)	

Variable	Level of Variable	Jumps (n)	Injury Incidence (cases/1,000 jumps)	Risk Ratio (95%CI)	Chi-Square p-value
Drop Zone	Sicily	11,898	8.7	1.00	<0.01
	Luzon	4,761	7.8	0.89 (0.61-1.29)	
	Geronimo	1,654	35.7	4.08 (2.98-5.59)	
	Normandy	1,598	9.4	1.07 (0.63-1.84)	
	Nijmegen	1,255	8.0	0.91 (0.48-1.74)	
	Holland	974	10.3	1.18 (0.62-2.24)	
	Rock Air Force Base	700	8.6	0.98 (0.43-2.26)	
	Clute	115	0.0	-----	
	Salerno	76	13.2	1.51 (0.21-10.65)	
Entanglement	No	23019	10.2	1.00	<0.01
	Yes	12	666.7	65.58 (43.10-99.80)	
Time From Redeployment to Jump	0-2 months	7,015	5.3	0.46 (0.31-0.69)	<0.01
	3-4 months	2,986	3.7	0.32 (0.17-0.61)	
	7-8 months	1,513	11.9	1.05 (0.62-1.74)	
	9-10 months	2,633	15.2	1.33 (0.91-1.96)	
	11-12 months	2,210	27.1	2.38 (1.71-3.33)	
	None in 2 years	6,674	11.0	1.00	

e. Table 5 shows the results of the backward stepping multivariate logistic regression analysis. There were 20,481 jumps (89 percent) that had complete data and could be included in the analysis (logistic regression required complete data on all variables). Independent risk factors for injuries included night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, and entanglements.

Table 5. Multivariate Association between Injury Risk and Risk Factors

Variable	Level of Variable	Jumps (n)	Odds Ratio (95%CI)	Chi-Square p-value
Time of Day	Day	14,115	1.00	Referent
	Night	6.366	2.01 (1.06-3.83)	0.03
Jump Type	Admin/Non-Tactical	13,897	1.00	Referent
	Combat Load	6,584	2.38 (1.43-3.97)	<0.01
Highest Wind Speed	0-1 knot	2,512	1.00	Referent
	2-4 knots	4,185	1.01 (0.57-1.80)	0.98
	5-7 knots	8,281	1.66 (0.97-2.81)	0.06
	8-10 knots	5,045	3.09 (1.73-5.52)	<0.01
	11-12 knots	458	4.02 (1.40-11.54)	<0.01
Dry Bulb Temperature	37-50 degrees F	1,917	1.00	Referent
	51-70 degrees F	4,184	3.45 (1.03-11.58)	0.05
	71-90 degrees F	9,954	3.03 (0.94-9.77)	0.06
	91-104 degrees F	4,426	5.50 (1.68-18.43)	<0.01
Entanglement	No	20,469	1.00	Referent
	Yes	12	245.32 (68.22-882.21)	<0.01

7. DISCUSSION. The present investigation identified the overall injury incidence for an operational airborne unit during training and examined risk factors for injuries during military parachute training. Support was provided for classic military airborne investigations showing that higher injury incidence was associated with higher wind speeds,[1, 5, 14, 16] night jumps,[1, 5, 8, 11, 14, 16] and combat loads.[1, 14, 16] The present investigation expanded our knowledge of jump-related injury risk factors by examining factors that have received little or no attention including, temperature, humidity, aircraft type, aircraft exit door, jump order, rank, drop zone, entanglements, and time from redeployment to jump.

a. Overall Injury Incidence.

(1) The overall crude injury rate of 10.5/1,000 jumps was similar to the incidence of 10.9/1,000 jumps reported in a study of a British operational unit where the investigator defined and collected injuries in a manner almost identical to the present investigation.[16] Another British study that collected data in a similar manner during WWII had a much higher injury incidence of 21.0/1,000 jumps,[5] but these data were obtained at a time when airborne techniques and equipment were in an early stage of development. In studies where more restrictive injury definitions were used (e.g., time loss injuries, hospital visits), incidences of 0.6 to 51/1,000 jumps have been reported. When all injuries and jumps were combined in the studies with restrictive injury definitions (6,408 injuries in 1,192,446 jumps) the incidence was 5.4/1,000 jumps.[8, 17, 22-28] Injury incidences in basic airborne training (post-1950) have ranged from 4 to 10/1,000 jumps. When all jumps and injuries were combined in these basic training studies (2,000 injuries in 300,589 jumps) the incidence was 6.7/1,000 jumps.[1, 11, 13, 14, 19-21] The variations in injury incidences may be attributed not only to differences in injury definitions and training experience, but also to the risk factors that likely differ in the different investigations.

(2) Three previous reports have involved Soldiers and drop zones at Ft Bragg, North Carolina.[10, 17, 26] One study[10] reported an injury incidence of 24.6/1,000 jumps for a single jump operation with troops jumping at night with combat loads. If only night jumps with combat loads were considered in the present study, the overall injury incidence was 18.7/1,000 jumps, somewhat lower. Two other studies[17, 26] surveyed parachute injuries at Ft Bragg from May 1993 to December 1994 and from May 1994 to April 1996. The crude injury incidences were 8.0 and 8.1 /1,000 jumps in the two periods, respectively. When only jumps onto Ft Bragg drop zones were considered in the present investigation the injury incidence was 8.6/1,000 jumps. However, the two previous studies at Fort Bragg examining jump operations over time[17, 26] only obtained injuries that were seen in the emergency room at the Fort Bragg Womack Army Community Hospital. In the present investigation, injuries were also obtained on the drop zone, some of which were not evacuated to the hospital. If only injuries evacuated

to hospitals and clinics in the present investigation were included (n=182) the injury incidence was 7.9/1,000 jumps, very similar to the two earlier studies.[17, 26]

b. Events Associated with Injury.

(1) Only three studies have actually reported events associated with military parachuting injuries,[17, 22, 25] although others have provided speculation and anecdotal observations on how injuries might occur.[5, 33-35] When events were reported in these previous studies, the categories for the events differed from those in the present investigation. Nonetheless, these previous studies provide at least some basis for comparison. Neel[22] reported on 140 parachute injury cases within the 82nd Airborne Division at Fort Bragg in 1946. At least 61 percent of injuries were associated with ground impacts and 6 percent were associated with aircraft exits. Farrow[25] provided details on all 63 injuries experienced by the Australian Parachute Battalion Group from March 1987 to December 1988. The battalion jumped from C130 Hercules and C7 Caribou (tailgate exit) aircraft using T-10 parachutes. Ground impacts, exit procedures, and tree landing accounted for 59 percent, 10 percent, and 6 percent, respectively, of activities associated with injury. This compares with 75 percent, 3 percent, and 4 percent, respectively, in the present investigation.

(2) Craig and Lee[17] reported on altitude injuries at Ft Bragg from May 1994 to April 1996 (24 months). Altitude injuries were defined as those occurring from aircraft exit to just before ground impact. They reported that 6 percent of all parachute injuries were of this type and that the incidence was 0.46/1,000 jumps. In the present investigation, if injuries associated with static lines, exit procedures, and parachute riser injuries were combined, they would account for 14 percent (23 of 160 injuries) of all injuries with a known event (23 of 160). However, Craig and Lee[17] only reported on injuries that were seen in the emergency room at the Fort Bragg Womack Army Medical Center. If only altitude injuries that were evacuated to the hospital were considered in the present investigation, these would be 5 percent (8 of 160 injuries) of all injuries, for an incidence of 0.35/1,000 jumps. Interestingly, the incidence of static line injury in Craig and Lee's study[17] was 0.15/1,000 (37 in 242,949 jumps) while the incidence of static line injuries evacuated to the hospital in the present investigation was twice as great, 0.30/1,000 jumps (7 in 22,981jumps).

(3) By far, the event associated with the largest number of injuries in the present investigation was ground impact. PLFs were introduced into the American Army in 1943. Weekly injury reports issued at the Fort Benning, Georgia Parachute School in 1943 suggested that injuries were trending downward before the PLF was doctrine but injuries were definitely reduced just after introduction of the PLF technique.[36-38] PLFs as executed today require that, prior to ground contact, the Soldier keep feet and knees together, with hips and knees slightly flexed. The Soldier makes ground contact with the balls of the feet, then rapidly distributes the kinetic energy of the impact through the

body by falling sideways and allowing the feet, calves, thighs, buttocks, and back to progressively make contact with the ground.[6, 28] This sequence of events can be made difficult or impossible if the ground is uneven or has obstructions; Soldiers may not be able to keep their legs and knees together or to make the required rapid series of ground contacts across the body. Wind conditions can exacerbate problems by causing parachute oscillations that result in greater impact energy. Winds from the front of the Soldiers can force them into a rear PLF which is very difficult to properly execute.

(4) Static line problems accounted for the second largest number of injuries in the present investigation. The 82nd Airborne Division requires that all static line problems be listed on flash reports. Static line injuries occur when the static line is not properly handed to the safety, if the safety does not properly clear the static line, or if the parachutist's arm is wrapped around the line on aircraft exit. Proper training in static line management and attention to detail when handing off the static line to the safety can reduce injuries of this type. Jumpmaster training should emphasize key elements in static line management so jumpmasters can recognize and rapidly correct situations where static line injuries might occur.

c. Entanglements.

(1) The entanglement incidence of 0.52/1,000 jumps in the present study was lower than the incidence of 0.87/1,000 jumps reported in Airborne School training at Fort Benning, Georgia.[1] The lower incidence may reflect the higher level of experience among the 82nd Airborne Division Soldiers. The primary cause of high altitude entanglements is assumed to be weak and simultaneous exits from opposite sides of the aircraft such that the aircraft slip stream forces jumpers towards each other as their parachutes deploy. Hadley and Hibst[24] studied a procedure called the controlled alternating parachute exit system (CAPES) in which jumpers exited the 2 sides of the aircraft at slightly different times (e.g., a 1 sec delay). This resulted in a substantial decrease in high altitude entanglements from 0.71/1,000 jumps in the year before the procedure was employed to 0.19/1,000 jumps in the first year that the procedure was first instituted. In practice, jumpers have a difficult time maintaining the separation. If a Soldier rushes the door or hesitates slightly, this can disrupt the timing and still result in simultaneous exits from both sides of the aircraft.

(2) When an entanglement occurred there was a high probability of an injury. Eight of the 12 entangled jumpers were injured and all but one of the entanglement-related injuries occurred among jumpers who remained entangled to the ground. It should be remembered that the number of entanglements was small, but nonetheless large proportion of injuries associated with the entanglements supports the training practice of instructing Soldiers to disentangle as soon as possible.

d. Wind Speed. A number of previous studies had shown that higher injury incidence was associated with higher wind speeds[1, 5, 14, 16] and this was an independent risk factor in the present investigation. Winds increase the horizontal velocity vector of the jumper and increase ground impact velocity when added to the vertical velocity vector. Winds can push a parachutist away from pre-planned drop zones into obstacles, rougher terrain, or trees. Tree landings are especially hazardous since a collision with a tree can be followed by an uncontrolled ground impact if the parachutist falls from the tree. High winds can also drag Soldiers on the ground after they land and before they have time to collapse their parachute canopies.

e. Combat Loads. A number of studies have shown that combat loads increase injury risk[1, 14, 16] and this was an independent injury risk factor in the present investigation. Extra equipment increases descent velocity resulting in greater impact energy. Since the extra equipment is lowered on a strap before ground impact and arrives on the ground before the jumper, the equipment may also create a landing zone hazard. It has also been hypothesized that combat loads may increase the risk of entanglements.[12] However, in the present investigation, there was only a small difference in entanglement incidence between administrative/non-tactical jumps and combat load jumps (0.41/1,000 jumps and 0.73/1,000 jumps, respectively, RR=1.78, 95 percent CI=0.58-5.56, p=0.30). It should be remembered that the number of entanglements was small (n=12) in the present investigation.

f. Night Jumps. Another classic injury risk factor is night jumps and this was an independent injury risk factor in the present study.[1, 5, 8, 11, 14, 16] During night jumps, there is less ability to see the ground, to perceive distance and depth, and to appreciate the direction of horizontal drift. These and other factors possibly contribute to less controlled landings, reduced ability to see obstacles on the drop zone, and higher injury rates.

g. Temperature and Humidity. Higher temperature was an independent risk factor for injury but humidity alone had only a modest influence on injury incidence. These data are generally in consonance with those of a single previous study that examined the influence of temperature and humidity on injury rates during Belgium (Belge) Airborne training.[14] Assuming a standard pressure of 1013.25 millibars and dry air (gas constant=297 J/kg*K), the density of air would decrease about 11 percent as the temperature increased from 40 to 95 degrees Fahrenheit (from 1.272 to 1.146 kg/m^3). The less dense air may result in faster descent velocities and this could influence injury rates.

h. Aircraft and Exit Doors.

(1) The present study found that the C17 and C130 aircraft had higher injury incidences than the other aircraft examined. Jumps from C23, C160, CH47 and UH60 were all daytime administrative/non-tactical jumps, at least partly accounting for the lower injury rate in these aircraft. Jumps from the C17 and C130 aircraft were all conducted at 800 feet above ground level, while jumps from the C23, CH47, and UH60 were conducted at 1250, 1500, and 1500 feet, respectively. Higher jump altitudes may have allowed jumpers to achieve better canopy control and provide more time to prepare for landing. Further, CH47 and C23 jumps were conducted off the tailgate of the aircraft and not off of side doors like the C130 and C17. In tailgate exits, jumpers hooked their static lines to starboard-side anchor cables utilizing a reverse or upside-down bite on the static-line with their left hand. This could have reduced potential static line injuries because it was less likely that a jumper’s hand or arm could be routed around the static-line. The distance between where the jumper released grip on the static line and the point where his feet left the aircraft increased significantly with tailgate exits. In rotary wing aircraft (CH47, UH60) jumpers have more space during exits and during descents, less probability of entanglements, and can better concentrate on landing procedures. Thus, some combination of higher jump altitudes, less probability of static line problems, and better jumper spacing during descents may explain the lower injury rates in the C23, CH47, and UH60 aircrafts.

(2) One previous study[16] compared jump injury rates between fixed wing and rotary aircraft and found that fixed wing aircraft had higher injury risk. As noted above, in the present investigation all jumps from rotary wing aircraft were administrative/non-tactical daytime jumps. If only administrative/non-tactical, daytime jumps were considered, injury rates in the present investigation were 6.5/1,000 jumps with the fixed wing aircraft and 0.6/1,000 jumps for the rotary wing aircraft (RR (fixed/rotary)=11.3, 95 percent CI=1.57-81.03), in consonance with Lillywhite.[16]

(3) In the univariate analysis, there was a higher injury incidence for the C17s compared to the C130s. This might have been largely due to the greater number of combat load, night jumps conducted with the C17 aircraft. The proportion of jumps involving combat load, nighttime missions was 34 percent for the C130s and 60 percent for the C17s. If only administrative/non-tactical, daytime jumps were considered, injury incidences for the C-17s and C-130s were 6.2/1,000 jumps and 7.0/1,000 jumps, respectively (RR(C130/C17)=1.11, 95 percent CI=0.35-3.52, p=0.86). As noted above, all jumps from the C160 were daytime administrative/non-tactical jumps and the injury incidence was similar to the C17s and C-130s under these conditions (7.7/1,000 jumps).

i. Drop Zone.

(1) Previous literature had indicated that airborne drops onto sand were less hazardous than jumps onto rougher terrain,[11] or onto dirt landing strips with uneven and unimproved areas around the landing area.[8] Eighty-nine percent of jumps covered by this report occurred at drop zones at Fort Bragg, North Carolina. These were Sicily, Luzon, Normandy, Nijmegen, Holland, and Salerno. There was little difference in injury incidence among these areas. Sicily and Holland have a mixture of sandy and hard-packed soil with sparse grass and other low lying vegetation. There is a hard packed dirt airstrip down the middle of Sicily and Holland and both are surrounded by dense pine forests. Additionally, Holland is located on top of a ridgeline with sloping sides and an Airfield Seizure Training Facility adjacent to the Landing Strip. Normandy and Salerno have similar terrain with the exception of a no Flight Landing Strip (FLS). Nijmegen drop zone is much narrower than the others, with prominently hilly terrain on the northern side. Nijmegen does have a dilapidated and overgrown FLS which is no longer serviceable. Lastly, Luzon drop zone is located on Camp Mackall, which is on the western side of the Fort Bragg reservation. It also has a FLS and its trailing edge borders a heavily traveled state highway. These drop zones have all undergone terrain changes in the last twenty years due to construction to control erosion.

(2) Eleven percent of jumps occurred at drop zones off Fort Bragg including Clute, Little Rock, and Geronimo. Jumps at Clute drop zone were performed as part of the 64th Annual Convention of the 82nd Airborne Division in Charleston, West Virginia. Jumps at Little Rock drop zone were conducted as part of the Little Rock Air Force Base Air Show near Little Rock, Arkansas. Jumps at Geronimo drop zone were part of an airborne insertion into the Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana. The single operation at Geronimo involved a night jump with combat loads from C130 (92 percent of jumps) and C17 (8 percent of jumps) aircraft. This was the first time an Airborne brigade combat team had conducted an operation of this size into the JRTC and the unfamiliarity with the drop zone paired with the large number of jumpers involved may have contributed to the high casualty rate.

j. Time from Redeployment. Shorter times from redeployment to jump operations were associated with lower injury incidences and injury incidence increased with longer times from deployment. When 82nd Airborne Division Soldiers returned from deployment, the Advanced Airborne School at Fort Bragg had been conducting refresher courses to help Soldiers return to ready status for their traditional rapid response mission. Instructors from the Advanced Airborne School at Fort Bragg, were also sent to Afghanistan and Iraq at various times to conduct a Jumpmaster Refresher Course for members of the 82nd Airborne Division who were preparing to return from their deployments. It is possible that these refresher courses for both the Soldiers and jumpmasters were effective in reducing the number of injuries on redeployment.

However, it must be remembered that the measure was crude since it assumed that all Soldiers in the unit had deployed and redeployed together and some Soldiers did not.

8. CONCLUSIONS AND RECOMMENDATIONS. The present investigation found an overall crude injury incidence of 10.5/1,000 jumps for 82nd Airborne Division Soldiers involved in Airborne training missions from 17 June to 3 December of 2010. Where an event associated with the injury could be determined, the largest risks were associated with ground impacts and static line problems. Static line injuries appear to be higher than in the past and training and procedural options to reduce injuries of this type should be considered. Risk factors for injuries included night jumps, combat loads, higher wind speeds, higher dry bulb temperatures, higher humidity, C17 and C130 aircraft (compared to other aircraft), exits through doors (as opposed to tailgates), entanglements, and longer times from redeployment to the jump operation. An appreciation of injury incidence, how airborne injuries occur, and factors increasing injury risk can assist medical and operational planners in further reducing the incidence of injury during airborne training operations.

9. POINTS OF CONTACT. Dr. Joseph Knapik (DSN 584-1328) joseph.knapik@us.army.mil; Tyson Grier (DSN 584-5450) tyson.grier@us.army.mil.

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APPROVED:

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APPENDIX A
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APPENDIX B

TRIP REPORTS ON COORDINATION VISITS TO FORT BRAGG, NORTH CAROLINA

MCHB-TS-DI 17 April 2010

SUBJECT: T-11 Parachute Injury Project

1. ISSUE. Trip to Ft Bragg NC 13-16APR10 to Coordinate T-11 Injury Project

2. FACTS.

a. Background: The Defense Safety Oversight Council (DSOC) approved and funded a project to examine the injury reduction effectiveness of the parachute ankle brace (PAB) in an operational unit. Many in the airborne community felt that the PAB was no longer necessary because the new T-11 tactical parachute system would significantly reduce injury rates. However, injury rates with the T-11 have not been systematically studied. The DSOC approved switching the funding from studying the PAB to examining injury rates with the new T-11 parachute. Depending on the injury reduction effectiveness of the T-11, the PAB issue may be revisited.

b. Details: Dr. Joseph Knapik, and Mr. Tyson Grier traveled to Fort Bragg, NC on 13APR10 to coordinate a project comparing injury rates between the T-10 and T-11 tactical parachute systems. The briefing packet used for the majority of the briefings is at Enclosure 1.

c. On 14APR10 we met with LTC Robert Malsby (82nd Airborne Division Surgeon), Mr Gleason, and MSG Beede in the 82nd Airborne Division Surgeon's Office in Gavin Hall. We briefed LTC Malsby on the project and answered his questions. LTC Malsby was very supportive of having Public Health Command (PHC) personnel on the drop zone working with the medics and collecting injury information. Mr Gleeson informed us that he had jump-related hospitalizations going back to the year 2006 and injury information on all Joint Forces Exercises (JFEXs) going back to March 2009. JFEXs involve 1,000-4,000 jumpers, depending on the exercise, doing parachute operations and then performing missions. All JFEXs are done at night. Mr Gleason's JFEX injury information only involved Soldiers who had injuries serious enough to report to the emergency room. Mr Gleeson said he would provide us with this information. If the injury information could be matched up with Flight Manifests (containing Soldier names) and Flash Reports (containing drop zone information on wind speeds, drop zones, time of day, combat loads, aircraft, and other information), it could be very useful historic data. MSG Beede suggested that medics on JFEXs be provided with simple cards where they could record information on Soldiers requiring jump-related care. Such a card might only contain the Soldier's name, diagnosis and anatomical location of the

injury.

d. We briefed the WOMAC Hospital Deputy Chief of Clinical Services (LTC Brian Burlingame) on the project. The hospital commander was not available since she was outprocessing.

e. We met with LTC Sassano (XVII Airborne Corps Surgeon) and COL Michael Smith (XVII Airborne Corps G-3) and briefed them on the project. COL Smith was very supportive of the project saying that he thought the T-11 should reduce injuries but it would be a good idea to know if this was true. He asked LTC Sassano to make appropriate arrangements with the G-3 Air and the units to get us the information we needed. This included drop zone access, Air Letters (jumps scheduled in the future, Enclosure 2), Flash Reports (Enclosure 3), and Flight Manifests (information on jumpers).

f. We discussed with LTC Sasanno obtaining past Flash Reports and Flight Manifests to link with LTC Malsby's retrospective injury data. We visited Drop-Zone Range Control and talked to Mr John Botello. Range control did not have Flash Reports but did have historic Drop Zone Logs (Enclosure 4) and Air Movement Tables (Enclosure 5). These forms did contain drop zones, drop times, and the number of jumpers. This is limited information but could be useful if retrospective flash reports could not be obtained. We also saw the Control Room which contained a large video screen showing the current jump operation.

g. We briefed Dr Ellen Segan on the project. She is the XVII Airborne Corps Science Advisor in the G-7 office (Strategic Plans and Modernization Office). Her background is in materials engineering. She was interested in discussing a sensor that she would like to test that measures forces and accelerations inside the helmets of Soldiers. We discussed the possibility of relating the forces and accelerations to closed head injuries and concussions. She asked us to serve on the sensor working group.

h. On 15APR10 we briefed MAJ Sakimura, SFC Bond, and a person who was from Program Manager Office-Clothing and Individual Equipment (Haymont, VA) and was training riggers on the T-11 parachutes. MAJ Sakimura is the commander for the Advanced Airborne School. The major suggestion offered at this meeting was to obtain the number of jumps each Soldier had. MAJ Sakimura and the others believed that more experienced jumpers were less likely to be injured. The number of jumps is contained in the Jump Logs which every battalion keeps for their Soldiers. Jump Logs contain at least names, units, and number of jumps for each Soldier. There is an attempt to include this in the new DTMS database. There was also considerable discussion about how to obtain injuries that happened on the drop zone but were not reported until later because the Soldier wanted to continue the mission.

i. We again met with Mr Brian Gleason in the 82nd Airborne Division Surgeon's Office and he provided us with the Airborne injury hospitalization data going back to 2006 and the JFEX injury reports. We also met with WO4 Hooker who is a 22 year rigger, currently serving with the XVIII Airborne Corps. He said he would get us flash reports from 1APR08 to 1APR10 that we could match up with retrospective medical data we obtained from Mr Gleason. He also provided us with samples of Air Letters and Flash Reports.

j. We again met briefly with LTC Sassano who provided us drop-zone surveys.

k. Finally, we met with Mr Scott Murray in the XVIII Airborne Corps G-3 Air shop. It was clear that he is the go-to person for the scheduling of jump operations. He provided us with maps of the drop zones and other samples of Air Letters, Flash Reports, and Air Movement Tables.

(1) In later conversations, Mr Murray told us that flight manifests can be obtained from:

(a) Drop Zone Safety Officer (DZSO) - Will be on drop zone and may or may not have a complete list

(b) Airborne Commander (Company Commander)

(c) Primary and Alternate Jumpmaster (but will be on the plane, and we would need to obtain before plane takes off)

(d) Brigade or Battalion S3

(2) Most accurate manifest to obtain would be a signed manifest (by jumpmaster) the next day after the jump has taken place. This can be acquired from the Battalion or Brigade S3.

(3) Flash Reports can be obtained from Mr Earl Jefferson who is the Ground Liaison Officer. His office is on Pope AFB off of Reilly Road, Bldg 900. He sends out all of the Flash Reports through e-mail. If we can get his e-mail we can get on the flash report distribution list.

l. We returned to Aberdeen Proving Ground on 16 April 2010.

3. POINTS OF CONTACT. Joseph Knapik (DSN 584-1328) joseph.knapik@us.army.mil; Tyson Grier (DSN 584-5450) tyson.grier@us.army.mil.

MCHB-TS-DI 29 May 2010

SUBJECT: T-11 Parachute Injury Project

1. ISSUE. Trip to Ft Bragg 25-28 May 2010 to Coordinate T-11 Injury Project

2. FACTS.

a. Background: The Defense Safety Oversight Council (DSOC) approved and funded a project to examine the injury reduction effectiveness of the parachute ankle brace (PAB) in an operational unit. Many in the airborne community felt that the PAB was no longer necessary because the new T-11 tactical parachute system would significantly reduce injury rates. However, injury rates with the T-11 have not been systematically studied. The DSOC approved switching the funding from studying the PAB to examining injury rates with the new T-11 parachute. Depending on the injury reduction effectiveness of the T-11, the PAB issue may be revisited. We visited Ft Bragg 13-16 Apr 2010 for initial coordination and to obtain approval to conduct the project. That visit is described in another trip report. On 21 May 2010, a tasking letter went out from the XVIII Airborne Corps G-3 describing the project to the Corps elements (Appendix A). We visited Ft Bragg for final coordination just after the tasker was published and this trip report describes actions on that visit.

b. On 25 May 2010, Dr Joseph Knapik and Mr Tyson Grier traveled to Ft Bragg. On 26 May 2010 we met with Mr Earl Jefferson, the Ground Liaison Officer (GLO), at Pope Air Force Base, near the Green Ramp (where jumpers are loaded). He informed us that he could assure that we received flash reports but flight manifests would have to be coordinated with his supervisor, Mr Nauck. Because flight manifests contained social security numbers they were considered somewhat sensitive. We found out that flight manifests contain loading characteristics of the Soldiers (what they were carrying). Seven copies of the flight manifests are made by the DACO and it was possible that an additional copy could be made for us which would be kept at the GLO Office until picked up.

c. We met with LTC Robert Malsby (82nd Airborne Division Surgeon) who had assembled the 82nd Airborne Division G-3 Air (CPT King Cooper, MGT Todd Winhoven), Operations Officer (CPT Meyers), Chief Medic (MSG Bissey), and the Deputy Surgeon for Clinical Operations (MAJ Robert Heath with CPT Ronald Salinger). CPT Cooper told us the G-3 Air organizes a meeting every Monday at 1000 that lays out the jumps for the next 2 weeks. Any changes to the jumps are discussed. We were invited to attend and told that if we hired contractors they could also attend. The meetings are held in Building 7620 (Ridgeway Hall). We could obtain Air Letters and

changes at that time.

(1) CPT Cooper advised us that on 5 June 2010 the first group of 500 T-11 parachutes would arrive at the rigger's shed. These would not be delivered to the units until August to September 2010. After the 500 parachutes, 1200 would be delivered each month. There were no plans to mix up parachutes in a single plane because of safety concerns; thus, a single plane would only jump a T-10 or T-11, but not both.

(2) MAJ Heath was in charge of the battalion aid stations (BAS) and suggested that Soldier jump-related injury visits to the BASs could be obtained by tasking the BAS supervisors to report them to the Division Surgeon's Office. We were told that there were too many BASs to try to do this on an individual basis. MAJ Heath asked us to develop a sheet that could be used to capture jump related injuries and the simpler the better. We told him we would develop both an excel spreadsheet and a word document that would have the information we would need.

(3) CPT Cooper suggested we look at stick position as a potential injury risk factor because this had been discussed in the past. MSG Bissey suggested we periodically weigh different duty positions to determine the total weight carried (e.g., mortar base plate, SAW gunner). MSG Bissey also suggested that the time a unit is back at Ft Bragg from deployment may be important. For example, a unit just back had typically not jumped in a while and might be more prone to injuries for that reason. Currently, the 2nd BCT had been back for 1-1½ years while the 3rd BCT had just come back in time for the January 2010 JFEX.

(4) To obtain accurate wind speeds it was suggested we obtain a Kestrel® 4500-5000 series device which can be quickly set up and downloaded to a computer on site. We observed that some flash reports only have wind ranges when multiple jumps are scheduled to take place over a specific period of time. Having our own wind/weather monitoring device would allow for a more complete analysis of weather factors in airborne injuries.

(5) CPT Cooper and MSG Winhoven took us to the G-3 Air shop in the Ridgeway building for further conversations. Everyone on the Drop Zone will need a helmet or hard hat. A 4X4 vehicle will be needed to get out to some drop zones. POVs are not allowed on the drop zone (due to falling objects that could crush or damage them), but the point where POVs can no longer travel is marked. Weather decisions for jumps are performed in Building 900 at Pope Air Force Base and it is often good to check there (on site) if the weather is questionable. The C-130 holds a maximum of 60 jumpers; the C-17 holds a maximum of 100 jumpers. JFEXs are currently scheduled for June 2010, August 2010, October 2010, January 2011, March 2011 and April 2011.

d. We visited the Rigger's shed and spoke with MSG Hamm. He told us the first T-

11s would arrive in the rigger's shop around 1 June 2010. A course was planned for the riggers the following week and it would be several weeks before all the riggers were up to speed on packing the parachutes. He did not anticipate sending packed parachutes out to the units until August 2010.

e. We went to the field to observe a jump on Normandy drop zone. We parked about 200 yards from the DZSO site and walked in with headgear. We checked in the DZSO who had not heard we were coming out but was accommodating never the less. He told us that he had laid out code letters to identify the drop zone for the pilot. There was a pole (called the ram) that, if down, would call off the jump and, if up, would say the jump was a "go". The unit that was jumping had been in Haiti for 3 months and this was their first jump since that deployment.

(1) We examined the 2 ambulances on site. Two medics were assigned to each ambulance and each ambulance contained as many as 4 sites for stretchers. The medics had medic bags and there were extra medical supplies on board.

(2) About 10 minutes from the first drop the assistant DZSO began communicating with the pilots. The 3 HUMMVs (2 ambulances and another HUMMV) around the DZSO started their engines in case they had to move for the jumpers. Sixty jumpers exited from the C-130 at 800 feet and landed. The plane made a second pass to let out the two jump masters. After all jumpers were down, the ambulances headed out to the field to check on the jumpers. The medics brought in one minor closed head injury which was caused by the jumper being forced to make a rear PLF. Medics reported this to the DZSO. The jumper was slightly dazed and the medics kept him for observation. We checked out with the DZSO and left the drop zone about 20 minutes after the jump.

f. There was some concern on the part of Mr Nauck (Chief of DPTM) as to whether or not we were authorized to obtain the flight manifests since they contained social security numbers. We visited his office. He had discussed the matter with COL Michael Smith (G-3, XVIII Airborne Corps) and COL Smith had provided us clearance. We visited Mr Earl Jefferson again and he said he had heard we were cleared for manifests and that once we began the project he would keep the manifests in a folder for us. Our plan is to get the information we need from the manifests and then shred them.

g. We met with Kevin Klug, *CTC* representative in downtown Fayetteville. *CTC* has the DSOC money to fund this evaluation. We told him the project would be 1 year in length and we would probably need 3 people to cover all the jumps. The ideal person would be a former 82nd Airborne medic. Mr Klug thought that 2 people might be enough if supplemented by personnel from his office, when necessary. We also told him that: 1) personnel will need 4-wheeled drive vehicles to get out to some drop zones, 2) all

personnel will need hard hats/Kevlar helmets on the drop zone, 3) he would need to purchase a weather meter and hardened computer to obtain wind speeds and other weather measures, 4) personnel will need clearance to enter Ft Bragg, and 5) personnel will need computers to enter data. We promised to get him information on the wind meter and construct the database. We told him that we would like to begin collecting data on 14JUN10. If he could not get the personnel by then, we would begin ourselves and phase in his personnel later. This is because we need baseline data on the T-10 parachutes before the T-11s are phased in.

h. Tyson Grier and Dr Knapik returned to Aberdeen Proving Ground on 28 May.

3. POINTS OF CONTACT. Dr. Joseph Knapik, joseph.knapik@us.army.mil DSN 584-1328; Mr Tyson Grier, Tyson.grier@us.army.mil, DSN 584-5450.

FM SC, FORT BRAGG AND XVIII AIRBORNE CORPS
TO CDR, 82D ABN DIV
TO CDR, 108TH ADA BDE
TO CDR, 20TH EN BDE
TO CDR, 82D SUST BDE
TO CDR, 525TH BFSB
TO CDR, 16TH MP BDE
TO CDR, CORPS HHB
TO CDR, 44TH MED BDE
TO CMDT, FORT BRAGG NCOA
INFO CDR USASOC
GARRISON/DPTM OPS
ACOFS, G3 (AIR), XVIII ABN CORPS
ACOFS, G7 XVIII ABN CORPS
SUBJ/T10/T11 PARACHUTE STUDY PROJECT, CNTRL NO. 10-05141547.
SITUATION/1. THE U.S. ARMY PUBLIC HEALTH COMMAND (PHC) HAS INITIATED A PROJECT ENTITLED "OPERATIONAL EVALUATION OF INJURY RATES DURING IMPLEMENTATION OF THE ADVANCED TACTICAL PARACHUTE SYSTEM (T-11)". THE DEFENSE SAFETY OVERSIGHT COUNCIL HAS FUNDED THE PROJECT TO EXAMINE INJURY RATES WITH THE NEW T-11 PARACHUTE IN COMPARISON TO THOSE OF THE T-10 PARACHUTE. THE PROJECT, COORDINATED WITH THE AIRBORNE AND MEDICAL COMMUNITIES, IS INTENDED TO HELP WITH MEDICAL PLANNING AND MAY ASSIST IN PROVIDING CHANGES IN AIRBORNE TRAINING TO IMPROVE SAFETY.
MISSION/2. XVIII AIRBORNE CORPS SUPPORTS THIS STUDY IN THE INTEREST OF IMPROVING SAFETY DURING AIRBORNE OPERATIONS.
EXECUTION/3. TASKS TO SUBORDINATE COMMANDS.
3.A. ALL AIRBORNE UNITS WITH XVIII AIRBORNE CORPS ARE ADVISED OF THIS ONGOING STUDY (APPROX. 1 YEAR) AND WILL OFFER THE FOLLOWING SUPPORT AND COOPERATION DURING THE PLANNING AND EXECUTION OF AIRBORNE OPERATIONS IN THE COLLECTION OF RELEVANT DATA.
3.A.1. DZSO'S WILL BE AWARE OF AND ALLOW ACCESS TO THE DROP ZONES DURING AIRBORNE OPERATIONS FOR AT LEAST ONE TO FOUR DATA COLLECTORS WHO MAY BE STATIONED ON THE DZ AT THE AID STATION/FLA FOR INJURY DATA COLLECTION.
3.A.2. THE S3/G3 AIR OF UNITS PERFORMING AIRBORNE OPERATIONS WILL PROVIDE A JUMPMASTER SIGNED JUMP MANIFEST TO MR TYSON GRIER, PHC, AT THE END OF EACH AIRBORNE OPERATION.
3.B. CORPS G3 AIR AND THE 82D ABN DIV G3 AIR WILL INCLUDE DR. JOSEPH KNAPIK, PHC, AND MR TYSON GRIER, PHC, ON THE DISTRIBUTION LIST FOR THE AIR LETTERS.
3.C. GARRISON DPTM, OPS, WILL INCLUDE DR. JOSEPH KNAPIK, PHC, AND MR TYSON GRIER, PHC, ON THE DISTRIBUTION LIST FOR FLASH REPORTS FROM THE GROUND LIAISON OFFICE (GLO).
3.D. BATTALION AID STATIONS WILL COORDINATE WITH DR. JOSEPH KNAPIK, PHC, AND MR. TYSON GRIER, PHC, TO PROVIDE INFORMATION ON MEDICAL VISITS FOR JUMP RELATED INJURIES.
ADMIN AND LOG/4. COORDINATING INSTRUCTIONS.
4.A. DIRECT COORDINATION BETWEEN PHC AND AIRBORNE UNITS (S3/G3 AIR AND DZSO'S) IS AUTHORIZED FOR THE PURPOSE OF INJURY DATA COLLECTION IN CONJUNCTION WITH THIS STUDY.
COMMAND AND SIGNAL/5. POINTS OF CONTACT.
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